SCIENCE

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MSS. intended or publication and books, etc., intended for review should be sent to the responsible editor, Professor J. McKeen Cattell, Garrison-on-Hudson N. Y.

A MAGNETIC SURVEY OF THE UNITED STATES BY THE COAST AND GEODETIC SURVEY.

IN the plan of reorganization of the 'survey of the coast,' adopted in March, 1843, explicit provision was made for magnetic observations.

Determinations of the magnetic declination were made at various points along the coast, under the superintendency of F. R. Hassler; the real work of magnetic observations, however, began with Superintendent Bache, who had previously made a magnetic survey of Pennsylvania and who had established the first magnetic observatory in this country, that of Girard College, Philadelphia.

Since that time the three magnetic elements, the declination, the dip and the intensity, have been determined by survey parties at various points in the United States, including Alaska, and in some foreign ports.

The general charge of this work, as well as the theoretical discussion which has given it value, has been in the hands of the Assistant Schott, Chief of the Computing Division, who has called attention from time to time to the need of a systematic prosecution of a magnetic survey of the country. It is largely due to Mr. Schott and his energy in that work that the present state of advancement has been reached.

In recognition of his contribution to Ter-

restrial Magnetism, the Paris Academy awarded him last year the Wilde prize of four thousand francs, which was personally presented by the President of the United States. This honor is especially *apropos* and particularly welcome to the friends of science in this country, inasmuch as Mr. Schott has just rounded out fifty years of magnificent work in the Survey.

With the addition of the islands of the Atlantic and of the Pacific which have come to the United States in the last year, and with the need for investigation of general laws of Terrestrial Magnetism for the whole globe, it seems that the time has now come for systematic magnetic operations, not only upon the continent of North America, but also on the islands in its vicinage. With the purpose of carrying forward such a magnetic survey and of completing in a reasonable time the collection of such data as may be necessary for a partial discussion of the problems of the Magnetic Field of the Earth, a new Division has been organized in the office of the Coast and Geodetic Survey, known as the Division of Terrestrial Magnetism. Dr. L. A. Bauer, formerly assistant professor of mathematics and mathematical physics at the University of Cincinnati, and editor of the *Journal of Terrestrial Magnetism* has been called to take charge of this new division of magnetic work.

The following general plan of work, which has been outlined as the basis for the magnetic survey of the United States and its adjacent islands may be of interest.

To indicate completely the laws which hold in the Magnetic Field of the earth, it would be desirable to have simultaneous observations at a vast number of stations over the continent of North America and of the adjacent islands. This is, of course, impossible, and the magnetic survey which must be made will necessarily depend on observations made at different times and reduced as accurately as possible to some mean epoch. To arrive at a first preliminary result, it will probably be necessary to make a general magnetic survey of the country, observing the magnetic elements at stations thirty or forty miles apart, making these stations more frequent in disturbed areas if necessary. The secular variations will necessarily be determined by repeating the observations at representative stations as the work goes on. The areas of the countries at present belonging to the United States are approximately as follows:

United States,	3,025,600	square miles,
Alaska,	577,390	" "
Hawaiian Islands,	6,250	" "
Puerto Rico,	3,530	" "
	3,612,770	

This area is nearly equal to that of all Europe and is one-fifteenth of the entire area of the globe. As magnetic surveys have been most vigorously prosecuted in Europe, it will be of interest to note the density of distribution of the magnetic stations in two recent, fruitful magnetic surveys, viz., that of Great Britain, where there was one station to every 139 square miles, and that of Holland, embracing one station to every 40 square miles.

Suppose we were to decide upon one station, on the average, to every 100 square miles—an end that we must hope to attain some day—then we should require the determination of the magnetic elements at 30,000 stations within the United States. At the rate of 400 stations a year, the magnetic survey, as detailed as this, would require for its completion 75 years. It is not well, however, to have a magnetic survey extend over such a long interval of years. The errors incurred in reducing the observations to a common epoch would greatly exceed the errors of observation.

It is evident that we must either have a very large number of observers and instru-

ments at our disposal so as to complete the survey within a short interval, say 10 years at the most, or we must content ourselves for the present with taking a less detailed survey.

Let us say that our present means will enable us to complete 450 stations per annum, of which 400 are to lie within the United States. Suppose that at the end of the year 1910 we shall have occupied 4,000 stations in the United States and have made the necessary 'repeat observations,' and that the stations have been to some degree uniformly distributed, then we shall have on the average one new station to every 756 square miles. Selecting as the epoch to which the observations shall be reduced January 1, 1905, we should then have with the addition of about 1,000 former stations, which we could utilize, a magnetic survey, the stations of which would be distributed at the average rate of one to every 600 square miles, or, approximately, one station to an area 25 miles, 40 kilometers, square.

This will give a very satisfactory representation of the distribution of the earth's magnetism within our confines and will suffice for the accomplishment of many of the practical purposes of magnetic surveys.

We will call this our 'first survey' and, as stated, its epoch 1905. We shall now be able to tell in what portion of the country more stations are needed. That is the density of the ultimate distribution of stations will not be a uniform one. In regions where the distribution of magnetism is fairly regular comparatively few stations will suffice, while in magnetically disturbed areas the number of stations must be increased in uniformity with the character and extent of the disturbance. The subsequent work will consist then in filling in stations where most needed and repeating observations at the 'repeat stations.'

In short, the plan of conducting a magnetic survey of this country which appears to be best suited to the present conditions, and one that is possible to carry out within a reasonably short time, is as follows: To make, first, a general magnetic survey of the country with stations about 25 to 30 miles apart; then, as opportunities present themselves, to observe more closely the magnetically disturbed areas. The observations at the 'repeat stations' made from time to time will furnish the proper secular variation corrections.

The great advantages of this plan over that of attempting a very detailed magnetic survey at once, the steady progress of which over the entire country, on account of its extent, would necessarily be very slow, will be readily perceived. The plan thus briefly outlined will make it possible within a reasonable time to construct two sets of magnetic maps for the same epoch, each set based upon a different distribution of the stations. An opportunity will thus be afforded, as in the case of the recent magnetic survey of Great Britain, to obtain some idea of the accuracy with which the iso-magnetic lines can be determined. The satisfactory solution of this question will serve as a valuable guide in future magnetic work.

Several State Geologists are making plans for detailed magnetic surveys of their respective States, in cooperation with the Coast and Geodetic Survey.

In addition to the observation of the magnetic elements at numerous points it is necessary to maintain a few magnetic observatories where continuous observations over a term of years will afford the data for comparing and reducing observations and for detecting the general changes in the earth's magnetic force. The Coast and Geodetic Survey has a number of years maintained such an observatory, for a time at Los Angeles and later at San Antonio, at which point the observations were brought to a close, as they have been in the

case of the Naval Observatory at Washington, by the interference of trolley wires.

Just what points will be chosen for the maintenance of continuous observatories will depend somewhat on the number of fixed magnetic observatories already maintained by universities and other institutions. With continuous records in Washington, Toronto, one point in the Northwest, Mexico and Havana, the magnetic fluctuations over the continent of North America ought to be fairly well followed. In addition to these a magnetic observatory will be established by the Coast Survey on one of the Hawaiian Islands, where its situation will not only supplement the data furnished by the observatories in the mainland, but by reason of its position in an isolated island may well be expected to add new facts to our knowledge of one of the most interesting, but one of the least perfectly understood, branches of physical science.

Henry S. Pritchett,
Superintendent.

THE JESUP NORTH PACIFIC EXPEDITION.

ETHNOLOGICAL WORK ON THE ISLAND OF SAGHALIN.*

The following report has been received from Dr. Berthold Laufer, who is in charge of the ethnological work of the Jesup North Pacific Expedition on the Amoor River and on the Island of Saghalin. The expedition is being carried on under the auspices of the American Museum of Natural History, the expenses being borne personally by President Morris V. Jesup. Dr. Laufer left New York in May, 1898, and went to Saghalin by way of Japan and Vladivostok. He spent the time from the summer of 1898 until March, 1899, among the various tribes inhabiting that island. He writes under date of March 4, 1899, as follows:

In the collections which I made on the Island of Saghalin there are a number of very interesting specimens. On my journey made in the course of last winter I succeeded in obtaining from the Olcha Tungus a collection of wooden idols and amulets made of fish-skins, which are quite new to science. I obtained from the Ainu of southern Saghalin a very interesting collection of ethnographical objects. I have had very good success in using the phonograph, and have obtained songs of the Gilyak and Tungus. The only difficulty is that the instrument cannot be used in the winter, owing to the effect of severe cold.

I intend to leave Saghalin the beginning of next week and continue my work on the Amoor River. It is my intention to devote a good deal of my time to the study of linguistics, since this part of my investigations has been least satisfactory. There are no interpreters on Saghalin capable of translating texts. There is no one who knows more than the most common phrases of Russian. Among the Ainu, Russian is entirely unknown, and for the purpose of interpreting I had to use Japanese, with which, however, they are not very familiar either. My knowledge of the Japanese language facilitated my work among them very much, since they like the Japanese very well. I succeeded in obtaining a great deal of ethnological material and information, traditions, and a large amount of grammatical and lexicographical material, although a short time only was available for this purpose. I collected most of my material among the Ainu during the night time, because it is only at this time that everything is astir. I have no detailed translations of this material, but expect to be able to make translations with the help of my lexicographical material and comparisons with the Ainu dialect spoken in Japan. There is a great difference between these two dialects. The Ainu of

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Yezzo have a vigesimal numeral system, while those of Saghalin have a purely decimal system. The latter dialect is much more archaic. Its morphology and phonetics are richer. I have also found the pronominal prefixes recently discovered by Bachelor. I am well satisfied with the results of my ethnographical researches among these people. I have obtained full explanations of their decorative designs. I did not succeed in obtaining any measurements. The people were afraid that they would die at once after submitting to this process. Although I had their full confidence, I could not induce them to submit, not even by offering presents which they considered of great value. In Korsakovsk I succeeded in measuring a single individual, a man of imposing stature, who, after the measurements had been taken, collapsed and looked the picture of despair, groaning, "Now I am going to die to-morrow!" The opinion that the Ainu are exceedingly hairy is decidedly exaggerated, at least so far as Saghalin is concerned. I have seen almost every single individual of the villages of the east coast of the island; and as I slept in their huts I had ample opportunity of seeing naked individuals, since they undress in the evening. By far the greater number of the men whom I have seen have no hair on their bodies, or at least no more than is found among Europeans. A more considerable amount of hairiness on chest and arms I have seen only in a few old men. Neither is the long beard characteristic of all Ainu. There are just as many with long beards as there are with short beards, or even without beards. I do not think that their type is homogeneous at all. I do not understand the reasons for Schrenck's statement that it is impossible to distinguish a Gilyak from an Ainu. It seems to me they may be distinguished with certainty, even from a long distance. I have no doubt that the information that I have collected on this island contains a very considerable amount of what is new. There are a great many errors in Schrenck's descriptions of the tribes of Saghalin. The Orok tribe, to which he refers, does not exist.

I started comparatively late on my journey along the east coast, because I was detained for two months and a-half by a severe attack of influenza. As soon as I had sufficiently recovered I went to Rykovsk, where the Gilyak were celebrating one of their bear festivals. I was welcomed with much delight, since I met several of my acquaintances of last summer. For five days I witnessed the ceremonial, and was even permitted to see the sacrifice of the dog, which is kept secret from the Russians. Then I travelled southward a hundred versts on horseback to Kasarsk, the southernmost Russian settlement on the central part of the island. I visited the whole valley of the Poronai as far as the mouth of the river on a reindeer sledge, and stayed for some time in the large Tungus village Muiko, where I had the great pleasure of obtaining additional information in regard to the texts which I had recorded during the preceding summer. I have measured almost the whole population of this area and collected statistical information. In this valley there are a number of Gilyak families who have begun to use the reindeer. I had also an opportunity of seeing a few Yakut. In December I reached Tichmenevsk, which is called Siska by the natives. This place is situated on Patience Bay. On the following day I started on an excursion eastward, in which I was particularly fortunate and successful. I obtained many specimens and much information on the Shamanistic rites and the ceremonials of the natives. When, later on, I had an opportunity to show my specimens to some Russians they were much surprised, since during the many years of their life on

Saghalin they had not seen anything of the kind. Then I visited the villages Tarankotan and Taraika, where I first fell in with the Ainu. I also visited the Tungus villages Unu, Muiko and Walit, after having passed the famous lake of Taraika. It was impossible to proceed farther eastward, since I received an official letter of warning not to proceed, because a few versts farther east a band of highwaymen consisting of escaped convicts had built a fort and were terrorizing the country. For this reason I returned without making the acquaintance of these gentlemen.

On New Year's Eve I reached Siska. On the following day I took phonographic records of songs, which created the greatest sensation among the Russians as well as among the natives. A young Gilyak woman who sang into the instrument said: "It took me so long to learn this song, and this thing here learned it at once, without making any mistakes. There is surely a man or a devil in this box which imitates me!" And at the same time she was crying and laughing from excitement.

On the second of January I started by dog-sledge for Naiero, where I had the best results in my work with the Ainu. Then I visited all the settlements on the coast as far as Naibuchi, which is 260 versts from Siska. This journey was exceedingly difficult, and sometimes even dangerous. At one time I narrowly escaped drowning when passing the ice at the foot of a steep promontory. I broke through the ice, which was much weakened by the waves. Fortunately, my guide, who was travelling in front of me, happened to capsize on his sledge at the same moment when I broke through. Thus it happened that he saw my situation and extricated me with his staff.

Towards the end of the month I arrived at Korsakovsk, making the distance from Naibuchi, about 100 versts, on horseback. Originally I intended to return from this point along the west coast of the island; but this proved to be impossible, as there is no means of communication in winter. For this reason I had to return northward the same way by which I came, and I had to travel as rapidly as possible in order to reach Nikolaievsk in time. Towards the end of March communication between the island and mainland over the ice is suspended. Therefore, I returned with all possible speed; working and collecting, however, when opportunity offered. The last few days I travelled day and night, camping a few hours, but not more than necessary to give the reindeer time to rest. At nine o'clock this morning I arrived here, having covered, since six o'clock yesterday morning, a distance of 200 versts.

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*ON THE BRIGHTNESS OF PIGMENTS BY OBLIQUE VISION.**

In the formation of any theory of color-vision the phenomena of color-blindness necessarily play an important part. This is especially true, of late years, of total color-blindness, or the absence of all color-sense. Of this phenomena there are three classes, exemplified by the eyes of those rare individuals who lack from birth all power of perceiving color by the normal eye in faint light and by the peripheral vision of the normal retina.

In each of these three cases the spectrum appears as a colorless band of graduated brightness. It was pointed out by Hering, in 1891, that the distribution of brightness in the first two of these three classes is the same, and it has been generally supposed that the color-blindness of the retinal periphery is of similar character. Von Kries showed, however, that this supposition was untrue (*Zeitschr. für Psychologie und Phys-*

*A paper read at the Boston meeting of the American Association for the Advancement of Science, August, 1898

iologie der Sinnesorgane, XV., pp. 247–279, 1897), the maximum brightness for peripheral as for direct vision in bright light being in the yellow ,and not, as in the other two classes, in the green.

According to the theory of Von Kries the visual mechanism used in bright light differs entirely from that used in faint light. The former distinguishes colors as colors, and finds the greatest brightness in the yellow of the spectrum, but requires a certain intensity of illumination before it can act at all. The other is insensible to color, seeing the spectrum, as stated above, as a strip of varying brightness, with its maximum in the green. As one who is born totally color-blind sees the spectrum in the same way, von Kries argues that in this case the 'brightness-apparatus' is absent or ineffective, and that vision is due entirely to the 'twilight-apparatus,' which in the normal eye becomes important only in faint light.

On the other hand, he goes on to say, the periphery of the normal eye acts "not (as the totally color-blind eye) by means of an absence of the 'brightness-apparatus,' and an exclusive use, therefore, of the 'darkness-apparatus,' but through a limitation or change in the functions of the 'brightness-apparatus.' In the language of the anatomical hypothesis, we must assume that even in the periphery of the 'brightness-adapted' eye the cones play the most important part, and that the color-blindness arises from a functional modification of the apparatus depending mainly on these elements, the 'brightness-apparatus.' This view is supported by the fact that the periphery values show approximately the same relations in the distribution of brightness as the color-perceiving portions of the eye, with the maximum near the sodium-line."

As this question is of considerable importance in the theory of color-vision, it seemed worth while to re-examine it with the flicker photometer, an instrument which appears excellently adapted to such a purpose. Its value in the study of ordinary color-blindness was pointed out by the writer in a paper read at the Detroit meeting of this Association, and Professor Rood, working with a flicker instrument of an entirely different type, has come to the same conclusion. The flicker photometer is also peculiarly adapted to the study of peripheral vision, since, as is well known, the peripheral regions of the retina are especially sensitive to appearances of motion or of changing brightness.

The instrument used in these experiments was of the revolving-disk type already described by the writer (*Physical Review*, Vol. III., No. 16, Jan.–Feb., 1896). To this instrument the arc of a circle was attached, the center of which was as nearly as possible the place occupied by the eye in front of the observing tube. This was marked in three points, at 30, 50 and 70 degrees from the line of direct vision. When the eye was directed on one of these marks observations with the sight tube could be made at the corresponding obliquity. All observations were made in a horizontal plane on the nasal side of the retina.

The conditions were those of ordinary photometric observation; the room was dark and the eye screened from any light except that under observation. Thus the eye was ,without doubt, partially 'adapted for darkness,' though the lights under observation were too bright to allow this adaptation to go very far. The sources of light were kerosene lamps, provided with Methven slits and burning a special high-grade oil. They were found to burn with great uniformity, but were checked by frequent direct observations. The right-hand lamp was used as a standard, was kept always in one place, and used to illuminate the revolving disk. The left-hand lamp illu-

minated the pigments to be studied, and could be moved along the bar. All colors were brought to the same intensity before observations, that is, the photometer, containing the colored card, was set at a definite distance from the right-hand lamp, and the other lamp moved backward or forward until a balance was approximately attained. It was left in this position, and the set of observations on any given color made by moving the photometer head in the usual way. Thus the uncertainties were avoided which arise from working with lights of small intensity.

Six colored papers were selected from the set published by the Milton Bradley Company—red, orange, yellow, green, green-blue, blue. Each of these was examined by direct vision, and at each of the three angles before mentioned. Two concordant series of observations, each involving a large number of readings, were made on different days, and the mean of the two series taken as the final result. It soon became evident that the pigments at the red end of the spectrum decreased in brightness from the center to the periphery of the retina, while those nearer the blue end increased in brightness. It seemed probable that some color must exist for which the brightness would be the same for all parts of the retina, and to locate this color more closely the intermediate pigments yellow-green and green-yellow were added to the set originally selected. The results are exhibited in Table I.

TABLE I.

	0°	30°	50°	70°
R.	.238	.128	.089	.079
O.	.603	.297	.227	.225
Y.	.902	.755	.674	.660
G.Y.	.602	.544	.503	.505
Y.G.	.463	.466	.459	.478
G.	.292	.347	.376	.391
G.B.	.245	.317	.329	.343
B	.107	.151	.175	.193

It is shown by this table that the yellow-green remains nearly at the same brightness for all angles of vision; that, in fact, the brightness curve for the whole set of pigments might almost be said to rotate about this color as an axis, the red falling and the blue rising as the periphery is approached. The character of the change is, perhaps, more clearly shown in Table II., which is derived from Table I. by multiplying each series of figures by a factor which brings the yellow-green value to unity, changing all other results in like proportion. The value for any color at any angle of vision may then be directly read as a percentage of the value for yellow-green.

TABLE II.

	0°	30°	50°	70°
R.	.514	.275	.194	.165
O.	1.303	.637	.495	.471
Y.	2.070	1.620	1.468	1.381
G.Y.	1.300	1.167	1.096	1.057
Y.G.	1.000	1.000	1.000	1.000
G.	.631	.720	.819	.818
G.B.	.529	.680	.717	.717
B.	.231	.324	.381	.404

It is thus seen that while the red falls in peripheral vision to about one-third of its brightness when viewed directly, and blue is nearly doubled in brightness, yellow is reduced in brightness by about one-third, and yellow-green, that portion of the spectrum where we should expect the greatest brightness if the peripheral color-blindness were of the same character as 'twilight' color-blindness, remains practically the same at all angles of vision. Yellow is still the brightest of the colors, and the maximum is shifted but little toward the blue.

It is to be noted, also, that there is comparatively little change from 50° of obliquity outward. At 50° most colors are still distinguishable; at 70°, none of them. At 50° the apparatus which gives us the sensation of color must still contribute its quota to the sensation of brightness, as in

direct vision. It is probable, therefore, from the similarity of the results at the two angles, that it continues to do so in the more peripheral parts of the retina, although it has lost its other function, of color-sensation.

The results at 70° confirm in a general way the measurements of von Kries. His results are given in Table III., with the column for 70° from the flicker experiments, both also reduced to the value unity in the yellow for purposes of comparison.

TABLE III.

	VON KRIES.		WHITMAN.	
	Original Values.	Reduced.	Original Values.	Reduced.
R.	1.35	.199	.079	.130
O.	4.03	.594	.222	.337
Y.	6.78	1.000	.660	1.000
Y.G.	.....	.....	.478	.724
G.	4.92	.726	.391	.592
B.G.	3.87	.571	.....	.....
G.B.	.....	.....	.344	.521
B.	.....	.....	.193	.292
V.	.86	.127	.....	.....

The two sets of measurements, though differing considerably in detail, show a progression in brightness of a similar character, especially as to the position of the maximum. An inspection of the table makes it evident that differences in the results might possibly be explained by the assumption of slight differences in the pigments used by the two observers; but it is perhaps more probable that the difference is a real one, caused by the fact that my observations were made in a darkened room, and, therefore, with an eye more 'adapted for darkness' than that of von Kries, who worked in a well-lighted place.

While it appears evident, as von Kries holds, that the color-perceiving apparatus is of importance in determining the brightness of any color peripherally seen, it is plain that—in the language of his theory—the apparatus for twilight vision plays a more important part than in the central portions of the retina. For the diminution of the reds and increase of the blues in brightness are characteristic only of faint illumination by direct vision—illumination fainter than the lowest at which the flicker method can be advantageously used (*Physical Review, loc. cit.*, p. 247), whereas they are shown by these experiments to exist in the outer regions of the retina under conditions of considerable brightness.

It may be said, in conclusion, that the brightness-sensation of the retinal periphery, so far as it differs from that of the central portions, differs from it in the same direction, though not so greatly, as in the other two types of complete color-blindness.

FRANK P. WHITMAN.

ADELBERT COLLEGE.

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*AN EXTENSION OF HELMHOLTZ'S THEORY OF THE HEAT OF THE SUN.**

ON the occasion of the Kant Commemoration at Königsberg, February 7, 1854, Helmholtz delivered an address on the 'Interaction of Natural Forces,' in which he laid the foundation of the modern theory of the sun's heat. The whole address, with the principal formulæ by which the numerical results were obtained, was translated into English and published in the *Philosophical Magazine* for 1856. In this paper the author discusses the conservation of energy, which he had been so instrumental in establishing upon a sound mathematical basis; and ascribes the maintenance of the sun's heat to the potential energy given up by the particles in descending towards the center of his globe. On the hypothesis that the solar sphere is of homogeneous density he subjects the problem to computation, and finds that the heat developed by a very small shrinkage of the mass will be sufficient to

* Read before the Philosophical Society of Washington, May 13, 1899.

account for the observed radiation. His principal conclusions may be summarized as follows:

1. That a shrinkage in the radius of 35 meters per year will generate sufficient heat to sustain the annual output of radiant energy.

2. That on this basis the radius of the sun would not shrink more than $\frac{1}{10000}$ part in 2,000 years, and this shrinkage could not be detected by any measurements which have been made within historical time. For the mean value of the sun's radius is about 961 seconds of arc, and is still uncertain by about one-half second; $\frac{1}{10000}$ of this radius is thus but one-fifth of the outstanding uncertainty in the sun's semi-diameter, in spite of all the labor which has been spent in finding its exact value by refined measurement. As the diameters noted by the ancients are much less accurate than those which can be inferred from the recorded duration of ancient eclipses in conjunction with the theory of the moon, we can only say that there is no evidence that the radius has diminished since the earliest ages. Even with the finest measurements now available, it would take ten thousand years for the shrinkage to become clearly sensible. There is, therefore, little hope that the shrinkage of the sun can ever be observed, yet from known mechanical laws we may confidently compute its amount, with even greater accuracy than we could hope to obtain from direct measurement.

3. That all the energy generated in the mass of the sun by the falling together of its particles would suffice to raise an aqueous globe of the same mass to a temperature of over 27 million degrees Centigrade. Pouillet estimated from experiments on solar radiation that the heat annually lost by the sun would raise the temperature of such a globe 1.25° C. On this basis the observed radiation of the sun could not have gone on uniformly in the past for more than about 22 millions of years. As more modern estimates increase the observed radiation appreciably, when full account is taken of atmospheric absorption, we shall adopt 18 million years as the past duration of the sun, on the theory of uniform radiation and homogeneous density assumed by Helmholtz.

4. Helmholtz further shows that all the energy given up by the condensation of the several planets amounts to but little more than $\frac{1}{100000}$ part of that developed by the condensation of the sun, and that the energy of the motion of the planets amounts to only $\frac{1}{447}$ of that resulting from the potential of the homogeneous sun upon itself. Thus nearly all the energy of the solar system has resulted from the condensation of the solar mass.

I propose this evening to present the results of a determination of the potential of the sun upon itself, when the mass is heterogeneous, or made up of successive layers of a uniform density, and the density follows the laws found by our countryman, Lane, just 30 years ago, for a gaseous body in convective equilibrium. The density of each layer can be found from Lane's theory. Beginning at the center and proceeding outward, we can thence determine the average density of the included spheres when successive layers of known density are added. (The speaker here explained the theory of the integration which he had developed, and said that the mathematical discussion of the process would appear in the *Astronomische Nachrichten*.) From an astronomical point of view the problem to be solved is best treated by some process of mechanical quadrature; and accordingly I have divided the radius into 40 parts, and by successive steps obtained an integral for the potential of the heterogeneous sphere upon itself, which is almost rigorously exact. It turns out that the condensation of the heterogeneous sun

has produced more heat than the homogeneous one, in the ratio of 176,868 to 100,000. As the energy of condensation of the homogeneous sphere represents a radiation of 18 million years, the potential of this heterogeneous sphere would, on the same basis, sustain radiation almost exactly 32 million years. Thus the effect of most of the particles of Helmholtz's homogeneous sphere falling towards the center to produce the heterogeneous sphere here treated *is to prolong the life of the sun through an additional period of 14 million years.*

It has been generally held by those who have studied the theory of the sun's energy that this fiery globe can hardly continue its activity after the diameter has shrunk to one-half its present value, which would increase the average density of the sphere eight times, and make it equal to 11.2 that of water. *If this supposition be admitted, it will follow that our sun has a total longevity of thirty-six million years, of which thirty-two millions lie in the past and only four millions are available for the future life of the solar system. Thus eight-ninths of the available potential energy of the sun has been spent, and only one-ninth is available for future use.* This conclusion is based upon the assumptions : (1) That the sun's mass is gaseous and the density follows the laws found by Lane ; (2) that shrinkage will essentially cease when the globe has attained the average density of 11.2 ; (3) that the ratio of the specific heat of the solar gas under constant pressure to that of the gas under constant volume is 1.4, as in common air and most terrestrial gases, and, moreover, that the average specific heat of the sun's mass is not enormously great, so that the latent heat of cooling would become a great source of energy after shrinkage had entirely ceased. All these hypotheses are extremely probable, and the first two will hardly be questioned by any one. For since Wilson and Gray (*Phil. Trans.*, 1894) find by experiment that the effective temperature of the photosphere is about 8,000° C., it will follow that the temperature of the body of the sun is very much higher. According to Lane's theory this would make the temperature of the nucleus about a quarter of a million degrees Centigrade. The matter composing the body of the sun is much above the critical temperatures of all known substances, and thus is necessarily in a gaseous state, though in the nucleus it may be so far condensed, under the enormous pressure to which it is subjected, as to act like a solid or fluid of great viscosity. On the other hand, even though the central density be 28 times that of water, while the photosphere is rarer than the terrestrial atmosphere, it is hardly conceivable that appreciable shrinkage can go on after the average density of the globe has increased to eight times its present value. For the resistances due to molecular repulsive forces must tend to overcome gravitation pressure, and thus render further contraction impossible. If this state be not fully realized when the sun's radius has sunk to one-half its present value, it must yet be so fully attained in the greater part of the body of the sun that what further shrinkage is possible in the external layers will produce little available energy for maintaining the sun's heat.

As to the average specific heat of the sun we can only say that water has the greatest specific heat of all known terrestrial substances, and it is not probable that the average specific heat of the dense gases composing the sun can be enormously greater than that of the specific heats of the corresponding gases found upon our earth. Thus it is not likely that our sun can long maintain its radiation after shrinkage has ceased.

From this investigation it seems that the future duration of the sun's heat can hardly exceed four million years, and a corre-

sponding limit is set for plant and animal life upon our globe.

T. J. J. See.

U. S. Naval Observatory, Washington, D. C., May 12, 1899.

ON THE NEW GENUS OF LAMPREY, MACROPHTHALMIA CHILENSIS.

The preliminary account of Dr. Plate's remarkable discovery published in the *Sitzungsberichte der Gesellschaft Naturforschende Freunde*, Berlin (1897, No. 8, pp. 137–141), has, as far as I am aware, received no comment in recent literature, although there can be little doubt that this remarkable Cyclostome has revived more of the important discussions as to the position of the Cyclostomes than any publication since the time of the classic pamphlet of Professor Dohrn, '*Der Ursprung der Wirbelthiere.*' And morphologists will, I am sure, await impatiently a further discussion of the anatomy of this newly discovered type, shortly to appear in the *Fauna Chilensis* in the Supplement Volume of the *Zoologische Jahrbücher*.

As the preliminary account is not readily accessible, it may be noted that this remarkable lamprey has large and normally developed eyes. It measures but 107 mm. in length, is of a brilliant silver-white color, and its sides are literally compressed, as in the case of many of the typical bony fishes. The back region is blue-black, with light yellow, dusky flakes on the anterior half of the forehead. It is also noteworthy that the sides of the body are perfectly smooth, lacking the markings of the muscles, common in other Cyclostomes. The nasal opening is slit-like, situated anterior to the eyes, and not opening in a papilla. The gill-slits are vertically compressed. The eye is of extraordinary size, 2.5 mm. in diameter, and resembles outwardly the eyes of a Teleost, with a circular pupil, 1 mm. in diameter. The dentition is relatively simple, and is said to resemble that of Myxine.

Plate has not as yet expressed his opinion as to the significance of his morphological prize; but, judging from a single phrase in his paper, he appears to regard it as a form which has not assumed parasitic habits, and has, therefore, not been subjected to degeneration. To what degree, however, will he support Dohrn's earlier teachings, which derived the Cyclostomes from a teleost-like ancestor? In any case, this discovery will by no means simplify the difficult problem as to the relationships of the Cyclostomes in general, for it is not unnatural to assume that if one of these forms has evolved normally developed eyes probably the others also may originally have possessed them, and that the present condition of cornea, lens and retina may reasonably be interpreted as degenerate instead of primitive. On the other hand, as far as the preliminary account enables one to judge, it is also possible to assume that under favorable conditions the Hyperoarte may have become highly specialized to the degree, indeed, of acquiring a more teleost-like body form, together with more completely developed visual structures. It is to be hoped that Dr. Plate has succeeded in collecting material which will throw light upon the relations of this new type from the standpoint of metamorphosis and embryonic development.

Bashford Dean.

NOTE ON THE SPAWNING SEASON OF THE EEL.

The recent and most interesting work of the Italian naturalists Grassi, Calandruccio and Ercolani has added, in all essential regards, the needed information regarding the spawning time, as well as the metamorphosis, of the eel. I do not find, however, in my review of the literature, any definite observations with regard to either

time or place of spawning of the eel in American waters, and I wish, therefore, to present a brief note on the only instance of a spawning eel which has, up to the present time, come within my notice. I had hoped to give further instances relating to this matter, but I have, unfortunately, been unable to secure additional data.

The general interest I have always had in the spawning of the eel has led me, from time to time during the past twenty-five years, to examine the condition of the ovary in numbers of specimens which have been brought to the New York markets during various seasons. The eggs which I have, however, noticed in this material were never larger than some which I observed twenty years ago in the so-called 'eel-fat,' that is to say, minute ovarian eggs, measuring possibly .03 mm. in diameter. It has long been known, in a general way, that in this neighborhood the eels are usually taken in great numbers during November and December, at the time of their passage seaward down the Hudson or in Gravesend Bay; and it has always been supposed that the spawning takes place within a month or so of this time, since in the early spring the elvers (*montées*), which ascend the rivers, are found never measuring less than two inches in length. That the actual spawning-time, however, may be a much later one, seems to me now more than probable for the following reason: On May 8, 1898, my attention was brought to an eel containing ova which separated readily from the ovary and filled the cavity of the abdomen, and I am able to give the following notes relating to this very unusual specimen. I find it was taken at Atlantic Highlands by Lewis Morris, in relatively shallow water, between two and three fathoms, in a locality which is well known as an eeling ground. The color of the specimen was relatively bright, but not unusually so, nor was the eye notably larger than in similar specimens from the same locality. The specimen was relatively small, measuring 42 cm. in length, and weighed but 135 grammes. The eggs are .4 mm. in diameter. A microscopic examination of the ova made by my friend, Professor Dean, of Columbia University, shows that the germinative vesicle is clearly defined, and that the egg is all but mature. The ova, as I have already noted, are readily shaken free from the ovarian tissue.

The distinct interest of this observation appears to be this, that the eel may, in exceptional instances at least, ripen its eggs in relatively shallow water, possibly in the inlets of many of the bays and sounds, instead of at the great depths which the European observers have hitherto regarded as necessary for sexual maturation. As far as I am aware, the only instance of the taking of a sexually matured eel has been in waters of one hundred or more fathoms in depth. In all these instances, moreover, the female eel has been of considerable size, at least half again as large as the present example.

The present specimen, moreover, gives us a clue to the spawning time of the eel in our neighboring waters; in any event, it demonstrates that here the season of ovulation, during the month of May or thereabouts, is certainly many months later than in the Mediterranean, for in the latter locality, according to Grassi and Calandruccio (*Fischerei Zeitung*, XXII., 428), the eggs can only be found between the months of September and January. I should note, however, that the possibility is not excluded that the present eel was of exceptional sexual characters, like the small examples of shad showing almost ripened eggs which are sometimes taken one and even two months in advance of the regular 'run.'

EUGENE G. BLACKFORD.

EVOLUTION OF THE EMBOUCHURE IN NORTH AMERICAN INDIAN FLAGEOLETS.

Instrument No. 76,164 in the U. S. National Museum, from the Cocopa Indians, is made of cane. The septum of the reed is not removed, but two small holes are burnt into the cavity, one on either side of the septum and the wood between the holes removed. By covering the upper hole and the intervening space between the holes with the finger and blowing in the upper end of the reed, a proper direction is given to the breath against the outer edge of the lower hole and a whistling sound is produced. Finger holes in the section below the septum enable the player to produce a variety of sounds.

The second step in the development of the embouchure is illustrated by instruments Nos. 107,535 from Tucson, Arizona, and 11,314 from the Apache Indians, in the same Territory. Both have the same style of embouchure as the first named. But a piece of cloth or deerskin tied over the upper sound hole and the space between the holes takes the place of the finger in directing the breath. It may be noticed that in none of the flageolets mentioned has the maker sharpened the edge of the lip or hole against which the wind impinges.

The third step is marked by instruments with a thin edge on the lip where the sound is made. In No. 8,429, from the Ree Indians, one section of quill is used to replace the finger or cloth in directing the breath, and another to form a sharp lip, and they are lashed down tight with sinew. In Nos. 72,884 and 94,005, from the Creek Indians, and in many other examples, the reed is replaced by a piece of soft wood split and hollowed to imitate the interior of the cane flageolet, and the pieces then joined with gum and thongs. In these the 'languid,' or languette, is left in the carving and the sound holes are united by an excavation as in 1 and 2. The air channel is formed by excavating a shallow notch in the upper edge of the diaphragm, or 'languid;' the lip being a thin piece of metal; the cover is a piece of wood, laid on and fastened with thong. This is usually carved and is a prominent feature in this style of flageolet commonly called 'courting flutes.'

The fourth and last step in this evolution is exemplified by No. 23,724, from the Sioux of Devil's Lake Agency. The air passage between the two sound holes is not cut out of the diaphragm between, but a metal plate extends over and beyond both holes, and there is a rectangular slot cut out of the metal long enough to expose both holes and of the same width as the holes. The carved cap is lashed on top of the metal plate so as to form the air passage, which is bounded by the diaphragm, the edges of the metal and the underside of the wooden cap.

The Ree specimen, No. 8,429, shows that the Indian flageolet was in use before the knowledge of the Europeans. This specimen consists of a tube of hard wood. Instead of making the embouchure like those in European whistles and flageolets, placing a plug with an air channel between it and the wall of the tube just above the sound hole, they have made a long hole or slot in the wall of the tube and plugged the bore, with the gum or wax so placed that the slot is open above and below the plug. This plug, or 'languid,' is not quite even with the outer surface of the tube; the upper portion of the slot is covered with a split quill, its lower edge being even with the lower face of the plug, or 'languid,' and the shallow space between the edge of the plug within the slot and the quill forms the air channel which directs the wind against the edge of another split quill lashed over the lower part of the slot to within a quarter of an inch or so of the upper quill, thus forming a modification of the Indian cane flageolets, but not of the European form at all.

This peculiar style of the Indian flageolet I have not met with, except among the Indians of the United States, and those chiefly west of the Mississippi. There are whistles made of bone, stone or other materials by the Indians of the United States which are of the European character and they may have been known before the coming of the Europeans. But the peculiar construction of the flageolet I have described is so different from the common form that I have no doubt of its entirely Indian origin.

E. H. HAWLEY.

SCIENTIFIC BOOKS.

Traité élémentaire de météorologie. Par ALFRED ANGOT. Paris, Gauthier-Villars. 1899. Pp. vi + 417. Price, 12 francs.

Professor Angot occupies the position of meteorologist to the French Bureau Central Météorologique, and is so well known to meteorological workers the world over, that a formal treatise from his pen will receive careful consideration. It is not too much to say that Angot is to-day the foremost meteorologist in France, and as such his treatise will be considered an authority in his own country. The question naturally arises: Does the book represent the meteorology of to-day?

The author in his preface explains that he is not giving a complete treatise on meteorology, but merely a non-mathematical presentation of the elements of the science. The subject of meteorological instruments and their use has been excellently presented by the author in his 'Instructions météorologique,' and he has omitted this from his present treatise; thus having more space to devote to the results of meteorological observations and theories.

Professor Angot remarks that little attention is paid to instruction in meteorology in the institutions of learning in France, and he refers to the contrast existing in the United States, where 'a great number of special chairs are devoted to meteorology in the high schools as well as in the universities.' I must say that I am surprised to learn of this activity in the study of meteorology in our country, for my own observation has revealed an almost utter indifference, in fact the indifference which comes from ignorance, to the claims of meteorology on the part of those who have the say of what shall and what shall not be taught in our schools and colleges. If there is any institution in the United States, except Harvard University, that devotes $500 a year to meteorological instruction I have not yet heard of it; and, looking at the matter from another point of view, it may be remarked that our publishers who have brought out works on elementary meteorology express a disinclination to have their fingers burned by a repetition of the experiment.

Angot has divided his work into five books, which follow a brief introduction. Book I. treats of the Temperature; Book II. of the Atmospheric Pressure and Wind; Book III. of the Water in the Atmosphere; Book IV. of the Disturbances in the Atmosphere; Book V. of the Forecasting of the Weather and Meteorological Periods.

In the introduction the author explains the derivation of average values, the various periodic changes which occur in meteorology and the significance of interpolation.

Under the heading Temperature there is given first an excellent chapter on actinometry, which is followed by the usual treatment of the periodic diurnal and annual changes of temperature, and their variations with change of altitude, latitude and continental or oceanic surroundings, and the distribution of temperature over the earth's surface. An unusually full section treating of the influence of temperature on vegetation, and a quite lengthy chapter on the temperature of the soil and water surface closes this book. The charts representing the geographical distribution of the temperature (and the other elements) show the convergence of the meridians, and are consequently an improvement on the ordinary Mercator's projection.

The treatment of the barometric pressure is especially full as regards the diurnal variation; and, as was to have been expected, the cause of the semi-diurnal oscillation is referred to as still unknown.

The general conceptions concerning the direc-

tion, force and velocity of the wind are fully explained, but it is not until the author reaches the subject of the causes of the wind, and its relations with the temperature and pressure, that the reader's greatest interest is aroused. For it is here that the modern aspect of meteorology really begins, and it is just here that the author encounters his greatest difficulties. He gives first the cause and maintenance of fluid motions as depending on the differences of pressure at the same level, and establishes the complete circuit of such movements of the air; he then proceeds to explain the meaning of the terms *isobaric lines* and *barometric gradients*. Then follow, in succession, the influence of the earth's rotation on the movements of the air, the curve of inertia, the formation of cyclonic and anti-cyclonic whirls, and the circulation of the air around centers of warm or cold air. After this comes the general circulation of the atmosphere; the constant winds, the 'Trades;' the seasonal winds, the monsoons; the diurnal winds, the land and sea breezes, mountain winds, etc.

I must confess to a feeling of disappointment upon reading this part of Professor Angot's book. I had hoped that he would have given us a simple, clear, logical development of the air circulation somewhat after the manner of Ferrel's theory, but which should include the views of the best European investigators. That is what we need; but the author has contented himself with the older method of a disconnected treatment of the different features of the atmospheric circulation, some of which have been treated in one way and some in other ways by the various investigators who first developed them. I think that all of those who have tried to present in an elementary manner the results of the later investigators concerning the 'circulation of the atmosphere' have attempted an impossible short cut in meteorological literature, and that there must first be written an advanced treatment of the subject, which can later be simplified for an elementary treatise. Until this elaborate treatise has been written I think that Ferrel's development of the subject as given in his 'Popular Treatise of the Winds' (New York, 1889) will still remain the best for presentation to the student or general reader. We must bear in mind that Ferrel preceded this popular exposition of the subject by his highly technical 'Recent Advances in Meteorology.'

In Angot's chapter on atmospheric humidity the sections on condensation and clouds deserve special mention, and the reproduction of cloud photographs are unusually good. Under rainfall the charts showing the continental distribution of this element are valuable.

The subject of meteorological optics is really too difficult for presentation in a very elementary treatise on meteorology, but the author has succeeded rather better than is usual in his brief treatment of the subject.

The development of the subject of cyclones, thunder-squalls and spout phenomena is very full; but Faye's theories are given perhaps undue prominence from the German and American points of view.

In this, as in other recent treatises, the subject of Weather Predictions has not the space devoted to it which its practical importance demands.

The last chapter takes up briefly the meteorological periods or cycles, and cosmic influences.

Taking Angot's book as a whole, there is a deliberateness of treatment of each topic which can only be attained either by the making of a bulky volume or the exclusion of many important topics which deserve mention; and in the reviewer's opinion the use of the work as a text-book will be lessened thereby, but its value to the general reader will be increased. The lack of an index is, however, a most serious drawback to the free use of the book as a work of reference, for it requires the knowledge of a specialist to be able to turn at once to minor topics by the aid of the rather full table of contents alone.

Professor Angot's 'Meteorology' is a much more important contribution to French literature than it is to the world's literature of the subject, and it will, undoubtedly, do a great amount of good in supplying French readers with information concerning the present condition of a subject of very rapidly increasing interest. The French meteorological literature of recent years has not been nearly as abundant as that of other countries, and we trust that

this new book may arouse to action other authors and publishers, and especially such as will devote their energies to the presentation of the new meteorology. FRANK WALDO.

The Genesis and Dissolution of the Faculty of Speech. A Clinical and Psychological Study of Aphasia. By JOSEPH COLLINS, M. D., Professor of Diseases of the Mind and Nervous System in the New York Post-graduate Medical School; Neurologist to the New York City Hospital, etc. Awarded the Alvarenga Prize of the College of Physicians of Philadelphia, 1897. New York, The Macmillan Company. 1898. Pp. viii + 432.

This volume, to which was awarded the Alvarenga prize of the College of Physicians of Philadelphia for 1897, is a monograph of importance. There is no more fruitful field of investigation than the various forms of speech disturbance, for the student both of psychology and pathological anatomy. That progress has been slow is due to the fact, as Collins points out, that observation and analysis of speech defect has been inaccurate and post-mortem examinations incomplete. If not offering very much that is new the book before us has the merit of calling attention to our deficiencies and of urging greater care in the future. The author shows from beginning to end an admirable grasp of his subject and a complete acquaintance with the literature, which he has used with skill to produce throughout an eminently readable and stimulating book.

The monograph opens with a chapter on 'Disorders of intellectual expression, known as aphasia.' This is largely a discussion and criticism of terms, the outcome of which is a general classification of aphasia as follows:

1. True aphasia—aphasia of apperception. Due to lesion of any constituent of the speech region, the zone of language.

2. Sensory aphasia. Due to lesion of the central and peripheral pathways leading to the zone of language.

3. Motor aphasia. Due to lesion of the motor pathways, over which motor impulses travel in passing to the peripheral speech musculature.

4. Compound aphasia. Any combination of two or more of these.

Such a classification the author regards as sufficient for all practical purposes, but as a concession to established usage he makes certain sub-divisions in order to avoid possible confusion of nomenclature. For example, he retains the word 'motor' as applied to aphasia produced by lesion of Broca's convolution 'solely becau-e such usage has been consecrated by time,' and not because he believes this center to be in reality entirely motor.

Following this chapter is a valuable historical sketch comprised in twenty-three pages, with a good bibliography. Charcot's autonomous speech centers are sharply criticised, both here and later in the book, and Dejerine's services to the subject receive the warmest appreciation, particularly because of their general opposition to Charcot's views.

Under the heading of 'An analysis of the genesis and function of speech,' Collins analyses, from the point of view of physiological psychology, the various elements which ultimately result in the development of the faculty of speech. It is clearly too large a subject for so cursory a handling, and on the whole is less satisfactory than the discussions which are concerned solely with the physical side of the process.

Chapter IV. concerns itself with remarks on the anatomy of the brain, the zone of language, and the evidence regarding a special graphic motor center. It is largely anatomical and presents with clearness the facts we should know relative to the structure of the brain in general, and particularly of those parts to which are attributed special functions in regard to speech. Flechsig's recently expressed views as to the zones of projection and the zones of association are narrated in considerable detail, because of their more or less direct bearing upon the conception of aphasia which the author has elaborated. Collins is definite in his opinion that the zone of language, made up mainly of Broca's convolution, the posterior portion of the first temporal convolution, and the angular gyrus, does not send fibers directly into the motor projection tract. The Rolandic cortex must first be called upon before an idea can be expressed as speech. He is equally confident that we now have sufficient evidence to overthrow com-

pletely Charcot's conception of four more or less independent centers and particularly of a so-called graphic center, and that we may confidently maintain that the zone of language is, as it were, a unit in its action, no part of which may be seriously injured, without in a measure impairing the entire mechanism of speech. These claims are supported by much skilful analysis of reported cases, and a careful reading leaves us with the conviction of the reasonableness of Collins' views.

The greater part of the remainder of the book is taken up with a more detailed consideration of the varieties of speech disturbance, frequently and pleasantly interrupted by the narration either of personal cases or of cases reported by others. In the discussion of motor aphasia much stress is laid upon a distinction too often overlooked, namely, that between *cortical* and *sub-cortical* motor aphasia. In the failure to recognize this distinction—and the same applies to sensory aphasia—Collins sees one of the greatest impediments to progress in our knowledge; and, conversely, the greatest possible hope for more accurate knowledge in the future must lie in the careful microscopic study of the brains of aphasic individuals, particularly when the lesion lies beneath the cortex. The details of differential diagnosis do not concern the present review, but these chapters are to be cordially recommended to those desiring something beyond a vague conception of the real problems of the future.

The diagnosis, etiology, morbid anatomy, treatment and, finally, the medico-legal aspects of aphasia are discussed in a somewhat less complete form, as the scope of the book amply justifies. Collins disagrees with certain other writers as regards the responsibility of the aphasic. His contention here is that in so far as internal speech is unaffected, or put anatomically, if the cortical areas for stored memories are intact, a person must be regarded as responsible, other things being equal. If, on the contrary, such areas are involved, *e. g.*, the area for motor word memories, the person's testamentary capacity should always be called in question. Hence, again, the extreme importance of determining whether the lesion leading to the speech defect be actually in the zone of language or in that part of the nerve mechanism which simply subserves the emission of words—sub-cortical.

In general the monograph must be regarded as a valuable contribution to American neurological literature. The subject-matter is presented in a scholarly way, and with a directness and certainty of his position which is characteristic of the author. It is to be regretted that Bastian's recent work should have been published too late to be fully included in Collins's critical analysis. On the whole the author's conception and treatment of his subject seem to us sound and representative of the best type of scientific discussion. He gives us few new observations, worked out with the detail, particularly after death, which he so urgently recommends, but this, no doubt, is due to lack of opportunity.

The style is for the most part clear. There is, however, a constant tendency to use unnecessarily pedantic words, for which we can find no excuse. In writing on scientific subjects simplicity of diction is surely a first requisite, and this Collins lacks. The following words and expressions are correct, it may be, but certainly not well chosen: 'Ancientness,' 'superambient cortex,' 'speechfulness,' 'cotton rain guard,' 'perishment,' 'disablement.' This is, however, a minor criticism in an otherwise excellent piece of work.

The book is admirably printed on rather unnecessarily heavy paper and the proof reading is almost faultless. An index adds materially to its usefulness and convenience.

E. W. T.

Codex Borbonicus. Manuscrit Méxicain de la Bibliothéque Du Palais Bourbon, Livre divinatoire et Rituel figuré. Publié en fac-simile avec une commentaire explicatif par M. E.-T. Hamy. Paris, 1889. Ernest Leroux, Editeur. Text pp. 1–24, introduction and 4 chapters. Plates folded screen fashion No's. 2–38 in colors.

This ancient Mexican book, formerly known as the Codex Législatif, is now published for the first time, in exact fac-simile, color, size and form. The original is on maguey paper, and

the drawing is the work of an artist, displaying an accuracy not seen in any of the other Mexican codices. It has been hidden from the world in the recesses of the library of the Chamber of Deputies, Paris. The writer had the priviledge of carefully examining it in 1895, in company with the Duke of Loubat, through whose generosity its publication has been made possible. The bright colors with which it was painted are still well preserved, and the whole codex is in excellent condition. The first two pages and probably the last two are missing, undoubtedly having been destroyed, or abstracted shortly subsequent to the conquest. The division and mutilation of the Mexican codices is a well-known fact. This book, folded screen fashion, is painted upon but one side, unlike the majority of the Pre-Columbian codices. The pages bear texts written in poor Spanish, partly explanatory of their meaning. The first 18 pages contain the *Tonalamatl*, the divinatory or astrological calendar of the Aztecs. The contents of the missing first two pages can be supplied by a study of the other ritualistic calendars, of the Codices Vaticanus 3773, Vaticanus 3738, Borgianus, Bologna and the Boturini-Aubin-Goupil Tonalamatl. This subject has been exhaustively treated by Dr. Ed. Seler. The *Tonalamatl* of the Codex Borbonicus is far more complete than any other yet published, and helps to clear up some of their obscure points. Pages 19 to 38 contain astronomical, religious and historical material of great interest, and somewhat resemble the paintings found in the Codex Telleriano Remensis of the National Library, Paris, and its counterpart Codex Vaticanus 3738. Pages 37 to 38 are instructive from the historical standpoint. Page 37 represents the two prophets who foretold to Montezuma the coming of the Spaniards to subdue the country. The dates: 1, Tochtli; 2, Acatl; 3, Tecpatl, 1506–7–3, accompany these figures, and suggest that the priests had heard of the appearance of the ships of Diaz de Solis and Pinzon off the coast of Yucatan in 1506, notice of which was undoubtedly carried to most parts of the culture area.

When all the old Mexican codices are reproduced separately then the study will be much simplified, and it is gratifying to note the progress now being made in this direction, at the present time several unpublished codices being in process of publication.

M. H. SAVILLE.

Pflanzengeographie auf Physiologischer Grundlage. Von DR. A. F. W. SCHIMPER. Mit 502 Tafeln und Abbildungen in autotypie, 5 Tafeln in Lichtdruck, und 4 geographischen Karten. Jena, Gustav Fischer. 1898. 8vo. Pp. vi + 876.

The appearance of this text marks a distinctive period in the development of phytogeography. The treatment is primarily ecological, but the floristic is presented so fully and woven in so logically that the arrangement is strictly phytogeographical in the best sense. Such a coordinate presentation of the subject-matter is novel. The standard texts, especially such classic ones as Humboldt's, De Candolle's and Grisebach's, have been almost wholly floristic, while Warming's recent Lehrbuch der Oekologischen Pflanzengeographie is, of course, purely ecological. Sketches of particular floras have, likewise, been floristic in character, to the practical exclusion of the ecological standpoint. Naturally, this does not mean that the author is the first to perceive the essential relation between floristic and ecology, a relation practically of cause and effect. The recognition of this fact is as old as Humboldt's first work. It does indicate, however, the advance made in systematizing and in making more thorough the methods of investigating the floral covering. The appearance of the present excellent text evidences the author's realization of his opportunity. The skillful manner in which the matter is handled bespeaks no small mastery of the subject. The volume contains a number of original and suggestive ideas, only a few of which can be mentioned here.

The work consists of three parts, the first treating of the factors in ecology, the second of formations and plant societies, the third of the zones and regions of the floral covering of the globe. The ecological factors considered in the first part are water, temperature, light, soil, atmosphere and animals. The treatment of each subject is as exhaustive as can be expected in a general text, especially in consideration of the enormous mass of detail available. In thorough-

ness and in manner of presentation of this portion, the book is probably without an equal. With respect to water content as a factor, Schimper's divisions agree with those of Warming, except that he uses the term tropophyte for mesophyte to apply to all plants not hydrophytes or xerophytes. The same criticism applies here that has been made elsewhere against Warming's mesophytes. The term is a convenient one, but it designates an ill-defined group and is almost impossible in application. The analysis of the conditions producing xerophytes is critical; such conditions are here grouped with reference to decrease of absorption and increase of transpiration. Under the former are ranged small water content, abundance of salts or humic acid in the soil, low soil temperature; under the latter, low degrees of humidity of the air, high temperature, low atmospheric pressure, intense illumination. Corresponding to these characteristics, xerophytic habitats are: (1) deserts and steppes, with a dry substratum and a dry atmosphere, often, also, with excessive heat and intense sunlight; (2) rocks and tree trunks, with low water content due to rapid drying; (3) sandhills, rubble, talus, with extremely porous soil; (4) seashore, solfatara, with abundant salts in solution in the soil; (5) moors, with humic acid in the soil; (6) polar areas, either in glaciated mountain ranges or in arctic latitudes, with extremely low ground temperature; (7) alpine mountains with rarefaction of the atmosphere and strong insolation. The consideration of hydrophytes and tropophytes is naturally much more restricted. Schimper regards water plants proper as descended from primitive unstable amphibious forms—a conclusion rather too theoretical to be generally accepted. He closes this section with a condensed statement of the relation of water to reproduction and to dissemination.

In the consideration of temperature the author expressly states that he regards this factor of primary importance. He places its treatment after that of water solely because the modifications due to the latter are more easily investigated and determined. The consideration of temperature extremes is followed by that of optimum temperatures, in which the work of Sachs and Haberlandt is largely drawn upon. Acclimatization is touched upon only briefly, for the most part with reference to Mayr's contributions. For the general reader one or two re-statements are interesting: that no portion of the earth's surface is too cold for plant life, as, with few exceptions, no portion is too hot; that it is nowhere too dark, nowhere too bright, for plant life. There is opportunity to take exception to the sweeping nature of these statements, but they are hardly intended to be taken as absolute. Under atmosphere is considered atmospheric pressure, air content of water and winds. The relatively much greater effect of the wind upon woody formations is pointed out, as also the influence of the wind upon transpiration. No mention is made, however, of the action of the wind in dune regions, sandhills and deserts, where it plays a primary rôle in the determination of the floral covering. The importance of winds in pollination and dissemination is treated briefly.

The chapter upon soil as an ecological factor is very skillfully summarized. Though brief, it is so comprehensive that recapitulation is impossible here; one can only reaffirm its excellence. The influence of animals upon vegetation has not been given as much attention as would be expected. Too little use has been made of the vast accumulation of data in this field. In many instances the ecological significance has not been fully wrought out. Moreover, a large number of important biological factors in ecology, arising from the interrelations of plants to plants, and of plants to the physical conditions, such as vegetation pressure, zonation, layering, etc., have been entirely neglected.

It is impossible to accept the author's grouping of formations into climatic and edaphic in the absolute way he seems to intend it. Forests, prairies and deserts are not purely, nor always primarily, determined by climatic factors. The so-called edaphic formations, determined though they are by soil characteristic, are often not formations, but zones or patches. They are but rarely coordinate with the author's climatic formations. The conception of the facies, moreover, differs from that of Drude, which has been accepted in this country. The division of the floral covering into forests,

prairies or steppes and deserts is, of course, primary and affords an altogether satisfactory basis for the arrangement of the formations. The statement that the constitution of the floral covering is determined by the three factors, temperature, hydrometeors and soil, is axiomatic; one is inclined, however, to give only partial assent to the conclusion that temperature determines the flora, hydrometeors the vegetation, and soil composition the formation. The analysis of the determining factors of forest, prairie and desert vegetation is excellent. Moderate frequency of precipitation is of first importance for forest vegetation. A rainy growing period is less favorable, the primary requisite being considerable water content in the soil, especially at some depth. The time of year in which the water supply is replenished is unimportant. The latter may occur throughout the year or only periodically. In the last case the rainy season may coincide for the most part, or entirely, with the growing period, as in the tropics and in the interior of Argentina, or with a period of relative rest, as in extra-tropical regions with wet winters, Mediterranean countries, Chili, California, south and southwest Australia. Forests are limited only by such degrees of dryness as prohibit all other vegetation, with the exception of fungi and algæ. The polar limit of forested areas is determined by dry winds during the season of frosts. Summarizing, a climate favorable to forestation presents the following conditions: warm growing period, constantly moist substratum, moist, quiet atmosphere, particularly in winter. It is unimportant whether the water content of the soil is supplied from meteoric or telluric sources, whether the precipitation is frequent or rare, coincident with the growing period or the period of rest. A climate with dry winters is unfavorable to forests in the highest degree, since the trees are unable to recover from the transpiration loss of the winter.

For prairies and steppes a moist substratum is unimportant, but a moist upper surface is essential. The most favorable conditions for grass vegetation are frequent, if only slight, precipitation during the growing period and concomitant moderate warmth. Prairies are affected little by the moisture of the substratum, except in the case of extreme capillarity of the surface, by the dryness of the air, especially during the period of rest, and by winds. Dryness in the maximum of the growing period, spring and early summer, is inimical, in a high degree, to grass vegetation. Axiomatically, in a climate favorable to forestation, forests predominate; in one favorable to grasses, prairies and steppes are the rule. In transition regions predominance is determined by adaptation to edaphic factors. Extreme departures from the mean favorable to forest or to prairie vegetation produce deserts.

It is impossible even to touch upon the third part of the volume, which constitutes by far the largest portion. It deals with the zones and regions of the vegetative covering of the earth. The latter is treated in the most exhaustive manner since Grisebach under the captions: tropical zone, temperate zone, arctic zone, montane regions and hydrophytic formations. Each zone is considered in a very logical manner with reference to the three main manifestations of the vegetation, forest, prairie and desert. The high value of the text is greatly enhanced by the large number of fine illustrations. It seems impossible to commend too highly this marked feature of the book. It may be regarded as significant of the time when phytogeographical results will be embodied, for the most part, in graphic fashion, in photographs, abundance-frequence indices and charts, and formational lists and contrasts.

FREDERIC E. CLEMENTS.
THE UNIVERSITY OF NEBRASKA.

Victor von Richter's Organic Chemistry. Edited by Professor R. ANSCHÜTZ, University of Bonn. Authorized Translation by EDGAR F. SMITH, Professor of Chemistry, University of Pennsylvania. Third American from the eighth German edition. Vol. I., Chemistry of the Aliphatic Series. Philadelphia, P. Blakiston's Sons & Co. 1899. Pp. 625. Price, $3.

Anschütz, in editing v. Richter's 'Organic Chemistry,' has raised it from the rank of a good descriptive manual to a place in the front rank of books on this subject. He has had the aid of Emil Fischer in the supervision of the chapters

on the carbohydrates and on uric acid; of v. Baeyer, Claisen, Waitz and others on the work in their respective fields.

The introduction occupies 77 pages, and among other subjects includes condensed presentations of the aims of physical chemistry and stereochemistry, of the work based on the optical and magnetic properties of carbon compounds, and of that based on measurements of conductivity. The book is written tersely and clearly. The nomenclature in common use is retained, but that recommended by the Geneva Conference is also given. The literature and historical references are abundant.

Professor Smith's translation is very good. A slip is on page 122, where wine is said to be obtained from 'St. John's berries;' a term not found in the Century Dictionary. The German word 'Johannisbeeren' means currants. The volume before us contains the results of the latest work on the subject, and, as the second (and last) volume on the aromatic series is promised by the publishers during the present year, the student purchasing this excellent book may feel confident that he has the last word on the subject up to the date of publication.

E. Renouf.

Physical Chemistry for Beginners. By Dr. Ch. van Deventer. With an Introduction by Professor J. H. Van't Hoff. Authorized American edition from the German edition. Translated by Berthram B. Boltwood, Ph.D., Instructor in Physical Chemistry in the Sheffield Scientific School of Yale University. First edition, first thousand. New York, John Wiley & Sons; London, Chapman & Hall, Limited. 1899. Pp. 154.

In the preface it is stated that "in the book at hand the author has endeavored to collect the most important results of physical chemistry in such a manner that this important branch of modern chemistry may be accessible to those who have not made an exhaustive study of physics and mathematics. The requirements of students of medicine and pharmacy, as well as of elementary chemistry, have been especially considered in the preparation of this work."

Chapters are devoted to the fundamental laws of composition, the properties of gases, thermochemistry, solutions, phenomena of light and the periodic system. It would seem that a chapter on electrochemistry would add to the value of the book.

The work has been used by Van't Hoff in connection with his lectures on chemistry to students in Amsterdam, and is spoken of as having furnished him welcome assistance.

The work of translation has been done with care by Dr. Boltwood, his purpose being, in part, to place in the hands of his own students a book which shall contain a clear and concise statement of the fundamental facts of physical chemistry.

Harry C. Jones.

BOOKS RECEIVED.

Das Tierreich. 7 Lieferung, *Demodicidæ* und *Sarcoptidæ*. G. Canestrium and P. Kramer. Pp. xvi + 193. M. 9.20. 8 Lieferung, *Scorpiones und Pedipalpi*. Karl Kraepelin. Pp. xviii + 265. M. 12.60. Berlin, R. Friedländer und Sohn. 1899.

Steinbruchindustrie und Steinbruchgeologie. O. Herrmann. Berlin, Borntraeger. 1899. Pp. xvi + 428. M. 10.

Essai critique sur l'hypothese des atomes dans la science contemporaine. Arthur Hannequen. Paris, Alcan. 1899. Second Edition. Pp. 457.

The Newer Remedies. Virgil Coblentz. Philadelphia, P. Blakiston's Sons & Co. 1899. Third Edition. Pp. vi + 147. $1.00.

The Psychology of Reasoning. Alfred Binet. Translated from the second French edition by Adam Gowans White. Chicago, The Open Court Publishing Co. 1899. Pp. 191.

SCIENTIFIC JOURNALS AND ARTICLES.

The first article in the *American Naturalist* for May is by H. S. Jennings, and is a continuation of 'Studies on Reactions to Stimuli in Unicellular Organisms.' The present part, III., treats of 'Reactions to Localized Stimuli in Spirostomum and Stentor,' the writer reaching the conclusion that the organisms react as individuals and not as substances. But while it will not do to think of their reactions as those of chemical substances, neither will it do to attribute to unicellular organisms the psychological powers of higher animals. Under the title of 'Vacation Notes, II., The Northern Pacific

Coast,' Douglas H. Campbell touches on the botany of that region. W. D. Matthew considers the question: 'Is the White River Tertiary an Æolian Formation,' deciding it in the affirmative. F. H. Herrick describes several cases of 'Ovum in Ovo,' and after classifying the various methods in which such abnormalities occur presents theories which account for them. The concluding paper by T. D. A. Cockerell is 'On the Habits and Structure of the Coccid Genus *Margarodes*.' Among the editorials is one on 'The Gypsy Moth and Economic Entomology,' in which the ground is taken that it is not worth while to continue the present extravagant policy. The number is unusually full of brief and good reviews of recent scientific literature.

THE March number of the *Bulletin of the American Mathematical Society* contains: 'On Singular Points of Linear Differential Equations with Real Coefficients,' by Professor Maxime Bôcher; 'The Hessian of the Cubic Surface,' by Dr. J. I. Hutchinson; 'On the Simple Isomorphisms of a Hamiltonian Group to Itself,' by Dr. G. A. Miller; 'Galois's Collected Works,' by Professor James Pierpont; 'Three Memoirs on Geometry,' by Professor Edgar Odell Lovett; 'Stahl's Abelian Functions,' by Dr. Virgil Snyder; 'Calculus of Finite Differences,' by Dr. D. A. Murray; 'Notes' and 'New Publications.' The April number of the *Bulletin* contains an account of the February meeting of the American Mathematical Society, by Professor F. N. Cole; 'Determinants of Quaternions,' by Professor James Mills Pierce; 'The Largest Linear Homogeneous Group with an Invariant Pfaffian,' by Dr. L. E. Dickson; 'Asymptotic Lines on Ruled Surfaces having Two Rectilinear Directrices,' by Dr. Virgil Snyder; 'Willson's Graphics,' by. Dr. J. B. Chittenden; 'Pascal's Repertorium of Higher Mathematics,' 'D'Ocagne's Descriptive and Infinitesimal Geometry,' by Professor Edgar Odell Lovett; 'Sophus Lie,' translation of Professor Gaston Darboux's notice; 'Notes' and 'New Publications.' The May number of the *Bulletin* contains an account of the April meeting of the Chicago Section of the Society, by Professor Thomas F. Holgate; 'An Elementary Proof that Bessel's Functions of the Zeroth Order have an Infinite Number of Real Roots,' by Professor Maxime Bôcher; 'A Generalization of Appell's Factorial Functions,' by Dr. E. J. Wilczynski; 'On the Arithmetization of Mathematics,' by Professor James Pierpont; 'Two Books on the Tides,' by Professor Ernest W. Brown; 'Notes' and 'New Publications.'

THE *Annals of Mathematics* will henceforward be published quarterly, beginning with the number issued on October 1st, by the department of mathematics of Harvard University. Professor Ormond Stone, of the University of Virginia, who founded and for many years supported the journal, has consented to act as a member of the board of editors in coöperation with Professor H. S. White, of Northwestern University, and Professors Byerly, Osgood and Bôcher, of Harvard University. The editors state that their object is to conduct the journal so that it may appeal not merely to the highly trained specialist, but to the general mathematieal public of America from students of mathematics in the graduate schools of our universities upward. Short research articles will be welcomed, but highly technical articles will be avoided. Articles containing little or no absolutely new matter, but giving a clear presentation of some important but not readily accessible field of mathematics, or a more thorough presentation of some subject which is generally treated in an unsatisfactory manner, are especially desired.

SOCIETIES AND ACADEMIES.

CHEMICAL SOCIETY OF WASHINGTON.

THE regular meeting was held on April 13, 1899.

The first paper of the evening was read by Mr. J. K. Haywood, and was entitled 'Some Boiling-Point Curves.' The results obtained have led to the following conclusions:

I. All mixtures of the following pairs of liquids boil at temperatures between the boiling points of the constituents: alcohol-water, alcohol-ether, chloroform-carbon tetra-chloride, acetone-water and acetone-ether.

II. A solution containing 17.5 % alcohol in carbon tetra-chloride distills without change at 65.5° approximately, under a pressure of 768.4 mm. of mercury.

III. A solution containing 12.5 % methyl al-

cohol in chloroform distills without change at 54° approximately, under a pressure of 770.2 mm. of mercury.

IV. A solution containing 12–13 % methyl alcohol in acetone distills without change at 55.9°, under a pressure of 764.8 mm. of mercury. The boiling point of this mixture is about 0.8° below that of the constituent which is present in greatest amount.

V. A solution containing 15–20 % of carbon tetra-chloride in acetone distills without change at a temperature but 0.05° below that of the pure acetone, and all mixtures containing more than 40 % acetone boil within one degree of the boiling point.

VI. The close proximity of the boiling points of the constituents appears to be a favorable condition for the existence of a maximum or minimum point on the boiling-point curve.

VII. In general one constituent remaining the same, mixtures with substances of similar chemical constitution yield similar boiling-point curves.

The second paper was read by Dr. F. K. Cameron, and was entitled 'Boiling Points of Mixtures.'

Dr. H. C. Bolton read an interesting paper on 'The Development of Pneumatic Chemistry,' which was profusely illustrated with lantern slides.

William H. Krug,
Secretary.

GEOLOGICAL CONFERENCE AND STUDENTS' CLUB OF HARVARD UNIVERSITY.

Students' Geological Club, April 11, 1899.—Mr. L. La. Forge reviewed Gregory's 'Plan of the Earth,' indicating several questionable steps in that writer's recent exposition of the subject. Mr. A. W. G. Wilson described a unique lake in Ontario, which is known as Lake-on-the-Mountain.

Geological Conference, April 28, 1899.—Mr. R. E. Burke communicated 'The Discovery of Fossils in the Roxbury Conglomerate,' and will publish on it at an early date.

Under the title 'Mineral Veins of the Mystic Quarries, Somerville,' Mr. R. B. Earle reported the results of his studies in that field. The veins, which are almost entirely limited to a dike and a sill, are composed chiefly of calcite, but include small amounts of quartz, pyrite and prehnite. The speaker divided the fissures which these veins fill into five classes according to their origin, which he believed to have been by contraction of the molten magma, by earthquakes, by tortion, by faulting or by decomposition. The growth and enlargement of these fissures, when once formed, was held to be mainly due to the expansive force of the vein-filling substance.

Mr. G. C. Curtis exhibited a topographic model, which he has constructed, of an area located in the eastern foothills of the Cascade Range, near the great bend of the Columbia River, in Kitattas County, Washington.

J. M. Boutwell,
Recording Secretary.

DISCUSSION AND CORRESPONDENCE.

TELEPATHY ONCE MORE.

To the Editor of Science: Why Professor Titchener should have taken an essay which he now admits to have completely failed even to make probable its point, as an example of the 'brilliant work' which 'scientific psychology' can do in the way of destroying the telepathic superstition, may be left to be fathomed by readers with more understanding of the ways of 'Science' than I possess.

Meanwhile, as one interested in mere accuracy, I must protest against two impressions which Professor Titchener, in your number of May 10th, seeks to leave upon the reader's mind.

The first is that whispering was first considered by Professor Lehmann. It has been elaborately discussed in the S. P. R. Proceedings over and over again. Sidgwick's 6-page discussion of it in the report of his own experiments is the basis of comparison used by Lehmann in his ampler but abortive investigation.

The second of Professor Titchener's implications is that it was Lehmann who introduced number-habits, and even forced the admission of them on the recalcitrant Sidgwick. Lehmann makes no mention of number-habits. Sidgwick himself introduces them to account, not for the thought transference results, but for the many errors common to the guesses of his Subjects and

Lehmann's; the two perhaps had the same number-habit. Does Professor Titchener seriously think that a number-habit in a guesser can account for the amount of coincidence between the numbers which he guesses and those upon counters drawn at random out of a bag?

Even in anti-telepathic Science accuracy of representation is required, and I am pleading not for telepathy, but only for accuracy.

WILLIAM JAMES.

ON THE WEHNELT CURRENT BREAKER.

TO THE EDITOR OF SCIENCE: The following facts, noticed while experimenting with the Wehnelt electrolytic current breaker, may be not without interest:

In order to test if the action of the breaker could be due to a spheriodal state, produced by the high temperature of the positive electrode, some means for measuring the temperature of this electrode had to be obtained. For this purpose I used electrodes of fusible metals melting at different temperatures, the temperature of the electrode being necessarily less than that at which the alloy melts, if the latter remain unfused. In this way one can at least obtain the superior limit for the temperature of the electrode. Starting with a fusible alloy which melted at about 78° C., the electrode melted as soon as the circuit was closed. The next metal used melted at 96° C., and was fused an appreciable, though very short, time after the current was established. Finally, using an anode made of a metal which melted at 168° C., no indication of fusion of the electrode could be detected, even after the breaker had run for ten minutes at a time. This seems to show that the temperature of the electrode was far below 200°, the temperature necessary, at atmospheric pressure, for the production of the spheroidal state.

The influence of self-induction on the action of the breaker was also studied, to some extent. Diminution of the self-induction in circuit diminishes the period of the action, as is shown by the heightened pitch of the sound produced. But absence of all self-induction prevents wholly the working of the breaker. The cell was used in a circuit composed of a storage battery, non-inductive electrolytic resistances and wires wound non-inductively. With this arrangement no interruption of the current could be produced, though the electromotive force was raised to thirty volts and the current to eighteen amperes. As soon, however, as a coil with self-induction was put in the circuit the action of the breaker recommenced. Induction in the circuit is essential to the action of this form of interrupter.

HOWARD MCCLENAHAN.

PHYSICAL DEPARTMENT, PRINCETON UNIVERSITY.

THERMODYNAMIC ACTION OF 'STEAM-GAS.'

ONE of the most valuable papers recently published in the fields of applied science is that which has just been reprinted from the *Revue de Mécanique* of the last year, the work of Professor Sinigagalia, a well-known author in that field.*

This is the latest and, in many respects, the most complete discussion of a supremely important subject; one to which the minds of men of science and engineers the world over are now again turning after a period of many years, during which the thermodynamic promise of gain in efficiency in the steam-engine through the conversion of a vapor into a gas by this process of superheating had been almost universally believed to be more than counterbalanced by the very serious difficulties met in the earlier days in the attempt to profit by it. Changes have taken place during the last generation which are now thought by many authorities to have largely reduced the obstructions formerly seemingly fatal to a great thermodynamic advance.

In the practical thermodynamic operation of the steam-engine, as M. Bertrand has remarked, there is no such thing as 'saturated vapor,' as that term is customarily employed by the thermodynamists. The working fluid is always, in fact, a mixture of vapor and its liquid, in a

*Application de la Surchauffe aux Machines à Vapeur par M. François Sinigaglia, Professeur agrégé des Ingénieurs de Naples; Ingénieur-Directeur de l'Association des Propriétaires d'Appareils à Vapeur dans les Province napolitaines. Extrait de la *Revue de Mécanique* (1897–98); Paris. V've Ch. Dunod, Éditeur, 1898.

state of instability as to quality. The investigations of the '*théorie générique*' made by Rankine, Clausius, Zeuner and others resulted in establishment of no rational expressions for the actual heat-exchanges of the real, as distinguished from the ideal, engine, and Hirn's '*théorié expérimentale*,' as developed by that great investigator and his disciples, is still the only resort of the student of the curious extra-thermodynamic processes accompanying the thermodynamic operation of the engine.

Superheating has come to be looked upon, not as method of giving superior thermodynamic action, but as simply a provision for reducing internal wastes due to heat-exchanges between the steam and the metal surrounding it. Its effectiveness was recognized as early as Trevethick's time (1828 or earlier) and became well understood about the middle of the century; since which time numerous inventions have been made, looking to its utilization, few giving any promise of success. The Alsatian school has revealed very completely the method and the effect of its adoption, and it has come to be well understood that its province is simply to reduce that form of waste known as 'initial condensation' or 'cylinder condensation.' Its successful use would effect the suppression of those losses in such manner, in the words of Dwelshauvers-Dery, as to give maximum efficiency by securing the exhaust of the steam from the engine in the dry and saturated condition. This is, in his opinion, the practical criterion of most perfect action. The actual gain has been found by Hirn to be, in several cases studied by him experimentally, from 20 to nearly 50 per cent., with a superheat amounting to from 210°C. to 245°C. The nearest approximation yet reported to the ideal, purely thermodynamic, case has been effected by this means—particularly, of late, by Schmidt.

The failures of the past have been due to difficulties in securing an apparatus which cannot be rapidly injured by excess of heat in presence of superheated vapor of water, and a system of lubrication of the cylinder and piston capable of working satisfactorily at the temperatures attained in effective superheating. The latter obstacle is now overcome, largely, by the use of the high-test mineral oils; the former remains a serious obstruction. The increasing steam-pressures of our day also reduce both the need and the availability of increasing superheat.

The results of successful superheating exhibit themselves both at the engine and at the boiler, and, as with multiple-cylinder engines, the gain at the boiler in economical employment of fuel is greater than that at the engine through a more perfect thermodynamic action; for the reduction of the demand for steam at the engine results in an increased economy in the production of such steam through the larger proportion of heating surface to weight of steam produced. Thus a gain of 20 per cent. at the engine may be accompanied by a gain of 22 per cent. or more in fuel as measured at the boiler. The desirable amount of superheat is that which will prevent the condensation of the vapor entering the steam-cylinder and insure its rejection as saturated vapor at exhaust.

The apparatus employed by various inventors and investigators in this field, from 1850 to our own time is described at considerable length by M. Sinigaglia, and the results of experiment are recited. In many instances, recently, particularly, it is reported that no serious inconveniences were met with in the application of this system; in other cases much trouble and sometimes serious accidents resulted, due to the 'burning' of the apparatus and its yielding, thus weakened, to the pressure. Messrs. Ludwig and Weber obtained, in an extensive series of experiments in Alsace, some very encouraging figures. An average gain of 7.5 per cent., net, was secured by moderate superheat (44°C.). Messrs. Walther-Meunier, and Ludwig, later, reported a gain of 13 to 15 per cent. from a superheat of somewhat greater amount. Schwoerer obtained a gain in efficiency of 15 to 18 per cent. by superheating 68°C. Hirsch reports similar figures from an equal amount of gasification in a marine apparatus. Schroeter obtained gains of 10 per cent. and more in a very elaborate and detailed investigation, in which the superheat amounted to 60°C. The most remarkable results reported are those of Schmidt, who, by adopting an enormous portion of superheating to heating surface (six to one), secured a superheat of 190°C., and at another time, with a

comparatively small apparatus, secured the highest record yet established. With another engine a gain in weight of steam supplied the engine amounting to nearly 40 per cent. was effected, and in weight of fuel 28 per cent; the difference being due, obviously, to the fact that each unit-weight of steam carried an abnormal quantity of stored heat.

Professor Sinigaglia concludes:

1. Superheating vapor is irrefutably proved to be the most effective system of reduction of internal wastes of heat in the steam-engine.

2. The higher the degree of superheating attainable, the nearer does the thermodynamic result approximate that indicated by pure theory and by the formulas of thermodynamics.

3. From the industrial point of view, it is necessary to note the gain, not at the engine, but in fuel demanded at the boiler, and the apparatus of vaporization and of gasification must be efficient and durable.

4. The final test is in the study of the financial aspect of the operation.

"Mais, aujourd'hui, les installations nombreuses de l'Alsace et de l'Allemagne ont donné des résultats si remarkables qu'on finira par vaincre les dernières difficultés qui s'opposent á une application générale de la surchauffe aux machines à vapeur. Ce sera le meilleur hommage rendu à Hirn et à son école."

R. H. THURSTON.

THE REMOVAL OF DR. WORTMAN TO THE CARNEGIE MUSEUM.

DR. J. L. WORTMAN, of the American Museum of Natural History, has been called to take charge of the new collections of Vertebrate fossils in the Carnegie Museum at Pittsburgh, and has resigned his position in the American Museum in order to enter upon his new duties. The finest portions of the Cope collection of Fossil Mammals were made by Dr. Wortman previous to his connection with the Army Medical Museum in Washington. Since 1890 he has had charge of most of the parties sent out from the American Museum for Fossil Mammals and Reptiles and has conducted these explorations with extraordinary success. A very large part, therefore, of the collections in the Department of Vertebrate Paleontology are due to the energy and intelligence of Dr. Wortman and his assistants in the field. His field work has been carried on almost exclusively during the summer months, and he has been occupied during the winters in the preparation of a series of bulletins based chiefly upon the field collections, many of which have attracted wide attention. Notable among these are the papers upon the Skeleton of *Patriofelis*, the Anatomy of *Agriochœrus*, the revision of all the early species of horses, and a geological paper upon the Stratigraphy of the White River Beds. The most important of his original contributions in the series is, however, that upon the 'Origin of the Sloths,' based chiefly upon the fortunate discovery of the foot of *Psittacotherium* in the Torrejon beds of New Mexico. Dr. Wortman's latest paper, now in press, is upon the Ancestry of the Dogs, in which he successfully demonstrates the direct phylogenetic relationship between the Canidæ and of certain dog-like Creodonts.

Dr. Wortman's services to the Museum are greatly appreciated and his resignation has been accepted with much regret. He carries with him the best wishes of his friends for his success in his new undertaking.

H. F. O.

SCIENTIFIC NOTES AND NEWS.

PROFESSOR F. L. O. WADSWORTH has been appointed by the managers of the Western Pennsylvania University, Director of the Allegheny Observatory, succeeding in the position Professors Keeler and Langley. Professor Wadsworth has been connected with Yerkes Observatory since its opening and was previously at the Astrophysical Observatory of the Smithsonian Institution.

UNDER authority of the Secretary of the Treasury, the Superintendent of the Coast and Geodetic Survey has effected a reorganization in that Bureau in such a way as to relieve the head of the Bureau of a certain amount of the routine work and to insure also a more direct supervision of the field work. The following officers have been appointed: Assistant Superintendent, Mr. O. H. Tittman; Assistant in charge of the Office, Mr. Andrew Braid; In-

spector of Field Work in Hydrography and Topography, Mr. H. G. Ogden; Inspector of Field Work in Geodesy, Mr. John F. Hayford; Inspector of Field Work in Terrestrial Magnetism, Dr. L. A. Bauer.

M. Prilleux, known for his researches on the parasitic diseases of plants, has been elected a member of the Section of Botany of the Paris Academy of Sciences. The other candidates nominated by the Section were MM. Bureau, Maxime, Cornu, Renault and Zeiller.

Three botanists—Professors E. Pfitzer, of Heidelberg; O. Brefeld, of Münster, and E. Warmung, of Copenhagen—have been elected corresponding members of the Berlin Academy of Sciences.

Mr. W. H. Preece, C.B., F.R.S., has accepted the presidency of the 18th Congress of the Sanitary Institute, to be held in Southampton from August 29th to September 2d.

Cambridge University has conferred the degree of Doctor in Science, *honoris causa*, on Alexander Kowalevsky, professor of zoology in the Imperial University, St. Petersburg.

The Prince of Monaco has been elected an honorary member of the Royal Geographical Society of London.

Mr. Philip Thomas Main, Fellow of St. Johns College, Cambridge, died on May 5th. He lectured on chemistry at St. John's College and did much to promote the study of natural science in the College and in the University. He was also the author of a treatise on astronomy which has passed through several editions.

Mr. Henry William Jackson, a retired surgeon, died at Louth, Lincolnshire, on May 14th, aged 67 years. He founded the Lewisham and Blackheath Scientific Association and was interested in anthropology and astronomy, being a member of the London and Paris Anthropological Societies and a Fellow of the Royal Astronomical Society.

Through some as yet unknown 'accident,' the annual appropriation for the N. Y. State Weather Service were stricken out of the appropriation bill, April 24th last, and it is thus apparently impossible to continue a series of observations, meteorological and agricultural, that has been carried on without interruption for a generation. In this service, which has its headquarters at Ithaca, in the College of Civil Engineering, nearly 2,500 persons are engaged without cost to the State, including the Director of that College, who is also the Director of the Service. The work of the Bureau has been largely in the interests of the farmers of the State, and the compilation of weekly 'Crop Bulletins,' and the maintenance of a weather-signal station, which operates in conjunction with the U. S. Bureau at Washington, has been considered an important service to the whole Commonwealth. The minute appropriations hitherto made, but $4,500 per annum, by the great State of New York have been entirely inadequate to the opportunities of the Bureau; but the volunteer labor of a corps whose services, if fully compensated, would amount to probably over a quarter of a million of dollars annually have gone far to make up for the defect. Even if re-established, this interruption for a single year will make a break in the files which can never be repaired and which may deprive the State of previously interested, and even enthusiastic, observers by so disheartening them that they will not resume their connection with the system; thus destroying stations having records of a length approximating thirty years.

A meeting was held on May 20th, at Columbia University, for the purpose of discussing the formation of an American Physical Society, which would hold meetings in New York for the reading and discussion of papers. The meeting was called by the following committee of physicists, representing important American universities: Professor A. G. Webster, Clark University, Worcester; Professor J. S. Ames, Johns Hopkins University, Baltimore; Professor E. L. Nichols, Cornell University, Ithaca; Professor Carl Barus, Brown University, Providence; Professor M. I. Pupin, Columbia University, New York; Professor B. O. Peirce, Harvard University, Cambridge; Professor W. F. Magie, Princeton University, Princeton. It is intended that the new organization shall be for this country what the Physical Society is for England and the Deutsche physikalische Gesellschaft for Germany.

THE Council of the American Chemical Society has authorized the establishment of a section to be known as the Philadelphia Section, with headquarters in Philadelphia, Pa., having a territory with a radius of sixty miles from the Philadelphia City Hall.

THE foundation-stone of the extension of South Kensington Museum, henceforward to be known as the Victoria and Albert Museum, was laid by Queen Victoria on May 17th. Several members of the royal family, foreign diplomatists and members of both Houses of Parliament were among those attending. The Duke of Devonshire, the Home Secretary, and Mr. Akers-Douglas took a prominent part in the proceedings. The Prince of Wales assisted the Queen in the actual laying of the foundation-stone.

A BILL has been introduced into the British Parliament for establishing a Department of Agriculture and other Industries and Technical Instruction in Ireland, and for other purposes conected therewith.

THE United States Civil Service Commission announces that applicants for the position of Inspector of Standards (Office of Standard Weights and Measures), U. S. Coast and Geodetic Survey (Treasury Department), at a salary of $3,000 per annum, will be permitted to file their applications as late as July 15, 1899, instead of June 1, 1899, as previously announced.

THE Examiners of the U. S. Civil Service Examination for a "*Sloyd* Teacher" in the Indian Service (Dept. Interior) failed to find candidates, April 11th. The examination will now be held June 6th–7th and the successful applicant will receive $600 per annum for teaching "basket *Sloyd*" and carving.

MAYOR VAN WYCK, of New York, has signed the resolution of the Municipal Assembly providing for the issue of $500,000 bonds to defray the expenses of removing the old reservoir from Bryant Park and building the foundations for the new library. The contract for the work will be let immediately by the Board of Estimate, and the work of tearing down the reservoir will be begun as soon as practicable.

AN anonymous gift of $25,000 has been made to Long Island College Hospital for the endowment of a fellowship in the department of pathology. The gift is to be known as the Van Cott Fellowship, in honor of Dr. Joshua Van Cott, the director of the laboratory.

THE French Chamber of Deputies has voted an annual appropriation of 92,000 fr. for the publication of the Photographic Atlas of the Stars.

THE French Association for the Advancement of Science will meet at Boulogne on the 14th of September, 1899. As we have already stated, the British Association will meet at the same time at Dover, the meetings of the two Associations having been arranged so as to provide for an exchange of hospitalities.

THE Indian Plague Commission has returned to London and is continuing its meetings in that city.

THE daily papers report that a letter from Andrée has been found on the northeast coast of Iceland and has been forwarded, as addressed, to Gothenburg, Sweden.

AN exhibition is being arranged at The Hague to illustrate what was accomplished by the Netherlands prior to the present century in navigation, discoveries, trade and fisheries. Those in America who possess objects that might be useful for exhibition are requested to communicate with the Honorary Secretary, Mr. G. P. Van Hecking Colenbrander, The Hague.

WE learn from the London *Times* that the two royal gold medals of the Royal Geographical Society have this year been awarded to two Frenchmen, both of them distinguished explorers. Only one French explorer, Francis Garnier, has hitherto figured on the Society's list of honors, and only one other Frenchman, Elisée Reclus. The founder's medal has this year been awarded to Captain Binger, who in the years 1887–89 carried out an extensive series of explorations in the vast area included in the bend of the Niger. During these journeys Captain Binger explored much country previously unknown, took numerous astronomical observations on which to base a map of the region, and in other departments of geography did a great amount of work of high scientific value. The results of Captain Binger's explorations were published in 1892 in

two large volumes, with one large map and several smaller maps and sections and numerous valuable illustrations, which form the chief authority on the geography of the region with which they deal. The patron's medal has been awarded to M. Foureau for his explorations in the Sahara during the last twelve years. In his journey to Insalah in 1890 he travelled over 1,500 miles and fixed the latitudes and longitudes of 35 places; in 1891 he penetrated farther into the Sahara than any other explorer since the Flatters mission, and determined the positions of 41 places; in 1893 he penetrated as far as the Tassili plateau; in 1894–95 he again covered much new ground and made numerous astronomical observations to fix positions, besides making researches in physical geography, geology and botany; in 1896 and in his present journey he contributed still further to geographical knowledge. The whole comprises an amount of continuous scientific work under great difficulties which places M. Foureau in the first rank of African explorers. Few men have done so much to elucidate the topography and the physical geography of the Sahara. The Murchison award has been given to Mr. Albert Armitage for his valuable scientific observations and for his sledge journeys with Mr. Jackson in Franz Josef Land; the Gill memorial to the Hon. David Carnegie for his journey across the Western Australian desert from Coolgardie to Hall's Creek and back by a different route, thus traversing the desert twice; the Cuthbert Peek grant to Dr. Nathorst for his important scientific exploration of the Spitzbergen Islands and the seas between Spitzbergen and Greenland; the Back grant to Captain Sykes for his three journeys through Persia, during which he has made important corrections and additions to the map of that country and done much to clear up the geography of Marco Polo. These honors will be awarded at the anniversary meeting of the Society on June 5th, and at the same time the American Ambassador will present to Sir John Murray the gold medal of the American Geographical Society for his valuable contributions to scientific geography.

The 30th annual meeting of the Iron and Steel Institute of Great Britain was opened on May 4th in the hall of the Institution of Civil Engineers, Westminster. The chair was occupied in the first instance by the retiring President, Mr. Edward P. Martin, who introduced his successor, Sir William Roberts-Austen, who delivered the inaugural address. The report of the Council for the past year was read by the Secretary, Mr. Bennett H. Brough, and showed that during 1898 the number of members was increased by 98, the total number on the roll at the end of the year being 1,522. With 57 members elected at the present meeting the total numerical strength of the Institute was brought up to 1,579. To the list of honorary members the names of King Oscar II. of Sweden and Norway and Baron Gustav Tamm, Governor-General of Stockholm and President of the Association of Swedish Ironmasters, were added during the past year. The annual dinner was held on the evening of May 4th, at which speeches were made by the Chairman, Sir William Roberts-Austen; Mr. Horace Seymour, Deputy-Master of the Mint; Sir William White, Director of Naval Construction; Sir H. Brackenbury, Director-General of Ordnance; Professor Rücker, Lord Lister, Lord Strathcona, Mr. Preece and others.

The Sixth International Congress on Commercial Education opened at Venice on May 4th, under the presidency of Signor Pascolata. It will next meet at Paris on August 26, 1900.

The report of the Council presented at the seventieth anniversary meeting of the Zoological Society of London stated that the number of Fellows on December 31, 1898, was 3,185, showing an increase of 27 during the past year, and the number of Fellows on the roll was in excess of what it had been in any year since 1885. The total income during the past year had been £29,208, being £495 more than that of 1897, and £3,357 in excess of the average during the preceding ten years. The increase in the income was attributable to the larger amounts received for admission fees, compositions and subscriptions, and also to the augmentation of the miscellaneous receipts caused by a contribution of Mr. Walter Rothschild, M.P., towards the outlay on the new tortoise house, built in 1898. The ordinary expenditure of the Society for 1898 had amounted to

£25,979, which was an increase of £649 over that for 1897. A sum of £3,718 had also been paid to extraordinary expenditure, having been devoted mainly to the construction of new buildings in the gardens and to the acquisition of a young male giraffe, which, although it arrived in apparently good health, did not, unfortunately, live long in the gardens. After payment of the ordinary and extraordinary expenditure a balance of £1,584 had been carried forward. The number of visitors to the gardens in 1898 had been 710,848, being 6,707 less than the corresponding number in 1897. The number of animals living in the gardens on December 31st last was 2,656, of which 818 were mammals, 1,363 birds and 475 reptiles and batrachians.

CONSUL-GENERAL HOLLOWAY, of St. Petersburg, sends to the Department of State, under date of March 28, 1899, translation of an article from the 'Novoe Vremia' of the 17th instant, referring to the first trip of the new 10,000-ton ice boat recently built in England for the purpose of keeping the ports of St. Petersburg and Riga open during the winter months, as follows: The ice boat *Ermak* arrived at Cronstadt March 5th–17th. This boat was made after plans prepared by Admiral Makaroff and built in England. Owing to the fogs, it had to remain two days in Belt. Near Reval it met with very thick ice, but still continued moving at 7 knots per hour. Near Seskei it met with large fields of ice, from 9 to 10 feet above the water line. Here the *Ermak* could not move on; but, with the aid of its machinery, it acquired a swinging motion, and the water running out of a special apparatus in the boat melted the ice under the vessel, which moved on, dispersing the ice mountains. The ice boat presses on the ice with its prow; the screw that is under it lets out water, which softens the ice, and the movement of the screw makes the ice go under it and breaks it into rather small pieces. This ice boat has no keel and should, therefore, be subject to great rolling, but, in order to avoid this, there is a receptacle in the hull of the vessel, filled with water, which is arranged in such a way that the water does not allow the vessel to sway too much one side or the other, and keeps it in equilibrium. The boat was met at Cronstadt with great triumph and music. Hundreds of people went out to meet it, running alongside of it on the ice. The ice boat belongs as yet to the Ministry of Finance. It is at the same time a passenger boat, a freight boat and a tug boat. It can accommodate nineteen first-class passengers, for which it has a fine cabin, decorated with imperial portraits, with double windows, double illuminators, and a special ventilator, which lets warm air into the cabin. The walls are of oak. The boat is lighted by electricity. On March 31st the Consul-General adds: "The new iceboat *Ermak* left Cronstadt on the 25th of March and opened the port of Reval, plowing through from 16 to 18 feet of ice, releasing three commercial steamers that were frozen fast some distance from the shore. On the morning of March 27th the *Ermak* left Reval, clearing the way to the sea for four vessels. During the first four days of the *Ermak's* arrival at Russian ports she released sixteen vessels from the ice and opened the way for them to proceed to sea."

UNIVERSITY AND EDUCATIONAL NEWS.

MR. SAMUEL CUPPLES has increased his gift of $150,000 for a building for Washington University, St. Louis, to $250,000 for two buildings.

MR. MAXWELL SOMMERVILLE has presented to the University of Pennsylvania his collection of engraved gems and ethnological collections, said to be of the value of $600,000.

THE *Jewish Chronicle* publishes full details of the bequests of Baroness de Hirsch. They amount in all to about $9,000,000, which is distributed chiefly among Hebrew charities throughout the world. The bequests include 7,000,000 fr. to the Teachers' Training School of the Hebrew Alliance at Paris and 3,000,000 fr. for elementary education in Galicia.

NECESSARY alterations are being made in the physical laboratory of Western Reserve University in order to erect an observatory upon it. The University has recently received a gift of a ten-inch refractor made by Messrs. Warner and Swasey. Mr. Samuel Mather, the donor of the laboratory, has offered to bear the expense of mounting the instrument.

HARVARD University has recently received two collections of shells which are at present being made ready for exhibition. One of these, given to the University by the heirs of Warren Delano, was made by Mr. Ballestier at the beginning of the present century and consists of specimens from the East Indies. The other is a very complete collection of American land shells made by Mr. E. Ellsworth Call.

THE Committee of Birmingham University announced, on May 18th, that the conditions attached to Andrew Carnegie's offer of $250,000 to the institution had been fulfilled, the subscriptions having reached $1,272,900. Mr. Chamberlain had also received a letter from the anonymous donor who had already given $187,500, offering an additional $62,500 if the proposed endowment is increased to $1,500,000.

IN view of the large increase in the number of students attending the Institute of Technology at Darmstadt, the sum of 1,137,000 Marks has been appropriated to enlarge the buildings and 45,700 Marks for equipment. In addition to these improvements, an engineering laboratory will be erected at a cost of 270,000 Marks.

OXFORD and Cambridge Universities have offered to admit to the privileges of affiliation graduates of McGill University and all matriculated students who have completed two academical years of study at McGill and have passed the intermediate examination for the degree of Bachelor of Arts. These terms, if accepted by the McGill corporation, will permit an undergraduate who has passed the intermediate examination to take his degree at Oxford or Cambridge in two years.

A COMMISSION has been established to take charge of the relations between the City and the University of Paris. It consists of members of the Municipal Council and officers of the University, with M. Gréard, Vice-Rector of the University, as President.

DR. HUGO MÜNSTERBERG, professor of psychology at Harvard University, will deliver the commencement address at the Women's College of Baltimore, his subject being 'The Relation of Psychology to General Education.'

PROFESSOR ALFRED CORNU, the eminent French physicist, has been appointed Rede lecturer in Cambridge University for the coming year.

PROFESSOR EDWARD H. KEISER, for the last fourteen years professor in chemistry at Bryn Mawr College, has accepted the professorship of chemistry in Washington University to succeed Professor Charles R. Sanger, who has been appointed to a position in the chemical department of Harvard University.

DR. HOWARD AYRES, professor of biology in the University of Missouri, has been elected President of the University of Cincinnati.

DR. F. C. FERRY has been appointed assistant professor of mathematics, and Dr. W. Waidner instructor in physics, in Williams College.

DR. C. E. ST. JOHN has been appointed professor of physics and astronomy in Oberlin College, and Dr. L. Dickson has been promoted to a professorship of mathematics in the University of California.

DR. F. H. SAFFORD, instructor in mathematics at Harvard University, has been appointed assistant professor of mathematics and mathematical physics at the University of Cincinnati to succeed Professor L. A. Bauer, whose appointment as Chief of the newly-established Division of Terrestrial Magnetism of the U. S. Coast and Geodetic Survey we announced last week.

THE table at the biological laboratory at Cold Spring Harbor, provided for by the John D. Jones Scholarship of Columbia University, has been filled by the appointment of Mr. John C. Torrey. H. C. Surface, of Cornell University, has been chosen to be the first beneficiary of the Dyckman fund for biological research. Mr. Surface is well known for his work on the fishes of New York State.

THE Babbot Fellowship of Vassar College has been awarded to Miss Anne Moore, assistant in biology. Miss Moore will spend next year in studying biology at Chicago University.

AT the University of Berlin, Dr. S. Schwendener, professor of botany, has celebrated his 70th birthday, and Dr. H. Munk, professor of physiology, his 60th birthday.